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**(54) Measuring the loading of
hydraulic excavators or the like**

**(57) A method of measuring the
loading quantity or loading
performance of an hydraulic excavator
or like loading device, which is
equipped with a bucket articulated to
a jib dipper arm and capable of being
tilted by piston-cylinder units, uses**

measurements of pressure in the
piston-cylinder unit disposed between
the bucket and the dipper arm and the
angle of the bucket to determine the
weight of the bucket content.
Successive weights can be added to
determine the quantity loaded by the
excavator in a transport vehicle or can
be indicated for determining the
performance in relation to a
predetermined interval of time.

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SPECIFICATION

Method of measuring the loading quantity or loading performance of hydraulic excavators or the like

- 5 This invention relates to a method of measuring the loading quantity or loading performance of hydraulic excavators or the like loading devices, which are equipped with a loading bucket articulated to a dipper arm and tiltable by piston-cylinder units.

- 10 A director measurement of the loading performance, especially of large plant items of the above-described type, is of interest to the operator and manufacturer of the appliance and is frequently desired. Thus, it may be of importance, for example, to know the total weight of soil dumped into a truck by means of a hydraulic excavator, in particular in order to draw conclusions about the weight of the load, or avoid overloading. It may also be of interest to know the performance of the excavator or indeed of the operating personnel per shift or per interval of time.

- Known devices are capable of detecting the moment applied by a load hydraulic excavator, in particular to avoid overloading of the excavator, itself. The moment depends upon the bucket content and upon the radius of the bucket relative to the jib articulation and is normally determined from the pressure in the basic jib cylinder and the angular position by means of potentiometers. If a limiting value is exceeded, a signal is emitted or the system is shut down.

- Known devices of this type cannot be used for measuring the loading quantity or performance, for which indeed they are not designed.

- An object of the present invention is to provide a method for measuring the quantity or performance applied in the loading of the bucket referred to a specific interval of time.

- According to the invention the following steps are carried out:

- a) after the bucket has been filled, the pressure in the piston-cylinder unit between the dipper arm and the bucket and also the angle of the bucket are measured in at least one position of the bucket,

- b) from the readings, the weight of the bucket content is calculated in a computer, using pre-input values which reflect the construction-imposed constant and variable forces on the empty bucket,

- c) the weight of the bucket content is indicated.

- In this way, evidence about the material weight and finally the stability moment of the excavator can be obtained, the measurement at the bucket or in the vicinity of the bucket being suitable for keeping the influence of errors extremely small.

- For the loading of a transport vehicle it may be of interest to know the number of loadings required for this vehicle. This can be realised according to a preferred feature of this invention, according to which it is proposed that the established weights of the bucket contents of a

- 65 plurality of working cycles be added together and indicated when called up.

- By counting the required number of bucket loadings, it is easy after the weights have been added, to establish the weight of the load of the transport vehicle. Working cycles may be measured by reference to a characteristic working movement which occurs once in every cycle, for example the opening of the bucket flap or door.

- Preferably, for determining the loading performance, the established weights of the bucket contents of several working cycles are added and indicated in relation to a predetermined interval of time.

- By an incorporated timer or the like, the performance of the excavator can be directly read off in this way, so that, for example, the performance for the loading of a single vehicle, or the loading of vehicles during a longer period of time, for example during one working shift, can be immediately determined. For this purpose only the start and end of the time interval need to be input.

- An example of the invention will now be described.

- Hydraulic excavators are in themselves well known and for this reason will not be described in detail or illustrated herein. A typical excavator has a main jib on which a dipper arm is pivoted, the jib and arm being independently movable by piston and cylinder units. The excavator bucket is articulated to the dipper arm and it tilted in use by a piston and cylinder unit extending between the bucket and arm.

- In accordance with the present invention, a sensor is provided to measure the pressure in the piston and cylinder unit acting between the arm and bucket. A sensor is also provided to measure the angle of the bucket relative to the arm. Such devices are well known and available to the man skilled in the art.

- Signals from the devices are fed to a computer which contains the necessary data and which has been pre-programmed to generate a signal indicative of the weight of the bucket from these signals. A signal is also fed to the computer once in every operating cycle, this signal being provided by a device responsive to opening of the bucket flap or door, for example. The weight of the bucket is displayed at this time on a suitable digital read-out device in the operator's cab. The weights of the bucket during the various cycles are summed in the computer, and a reading for the total weight provided. This reading may be given in response to a signal generated by an operator to indicate that a transport vehicle has been loaded. Alternatively, that summed total weight may be indicated which is measured during those cycles intervening between start and stop signals generated by a timer. A constant indication of the efficiency of the excavator or the shift using it may thus be provided per unit operating time.

CLAIMS

1. A method of measuring the loading quantity or loading performance of a hydraulic excavator or

other loading device which is equipped with a loading bucket articulated on a dipper arm and tiltable by at least one piston-cylinder unit, comprising the steps of:

- 5 a) measuring the pressure in the piston-cylinder unit between the dipper arm and loading bucket and the angle of the bucket in at least one position of the bucket, following filling of the bucket,
 - b) calculating the weight of the contents of the
10 bucket by means of a computer, into which has previously been input values which reflect the constructionally imposed constant and variable forces on the empty bucket,
 - c) providing an indication of the weight of the
15 contents of the bucket.
2. A method according to claim 1, wherein established weights of the bucket contents of several working cycles are added and indicated when called up.
- 20 3. A method according to claim 1, wherein, for determining the loading performance, the established weights of the bucket contents of several working cycles are added and are indicated referred to a predetermined time
25 interval.
 4. A method substantially as hereinbefore described with reference to the foregoing example.